Nonlinear Guided Wave Circular Array System for Microcrack Monitoring in Spacecraft, Phase I

Completed Technology Project (2014 - 2014)

Project Introduction

Reliable monitoring of the microcrack formation in the complex composite structure components in NASA spacecraft and launch vehicles is critical for vehicle operations. Early diagnosing and reporting vehicle capability has tremendous impact on mission readiness, safety, and life cycle cost. Microcrack formation in complex composite structure components can be challenging from a monitoring and evaluation point of view by traditional non-destructive evaluation methods, especially in the early stage. FBS, Inc proposes to develop a nonlinear guided wave circular array system for the SHM of microcrack formation in complex composite structure components of spacecraft and launch vehicles. The innovation here is the combination of guided wave circular array with nonlinear characteristics for microcrack SHM. Guided wave circular array has the capability of inspecting large areas with a small number of sensors and minimum wire connections. Magnetostrictive sensors will be used to build the array as they are flexible, sustainable to environmental temperature changes, and inexpensive. Nonlinear higher order harmonic guided waves will be emitted when fundamental guided waves impinge onto a microcrack. The nonlinear receiver will be built at the center of the circular array. The transition between fundamental to higher order nonlinear guided waves can be used to quantify the microcrack formation in complex composite structures.

Primary U.S. Work Locations and Key Partners

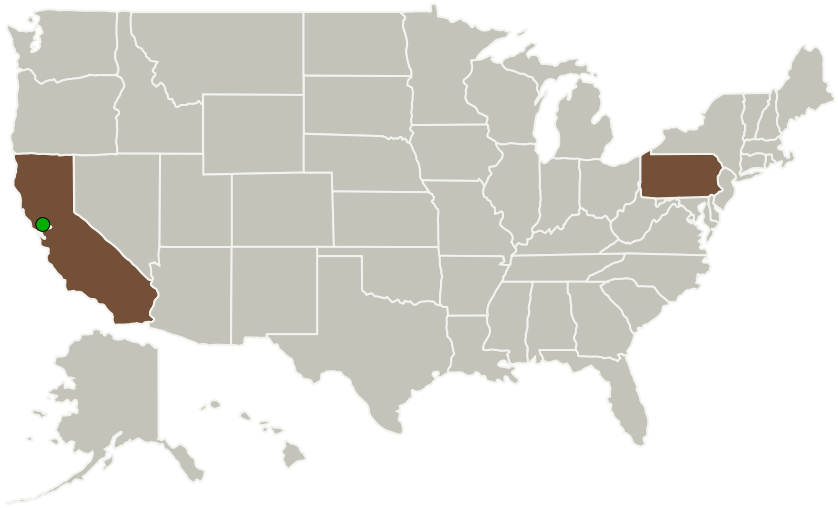

Table of Contents

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

FBS, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

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Organizations Performing Work	Role	Type	Location
FBS, Inc.	Lead Organization	Industry	State College, Pennsylvania
Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations	
California	Pennsylvania

Project Transitions

June 2014: Project Start

December 2014: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137570)*

Images

Project Image

Nonlinear guided wave circular array system for microcrack monitoring in spacecraft Project Image *(https://techport.nasa.gov/image/134729)*

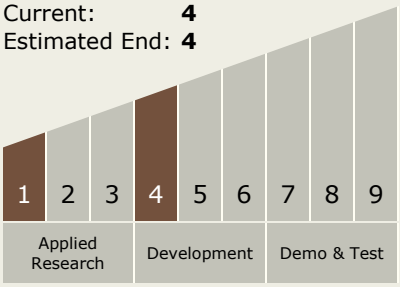
Project Management *(cont.)*

Principal Investigator:

Jing Mu

Technology Maturity (TRL)

Start: **1**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - TX07.3 Mission Operations and Safety
    - TX07.3.2 Integrated Flight Operations Systems

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System